ISSN 2616-5783 Vol.8, Issue 2: 7-14, DOI: 10.25236/AJHSS.2025.080202

Data-Driven Reform of Precision College English Teaching in the Era of Educational Digital Transformation

Wen Gong[1,2]

[1]School of Foreign Studies, Lingnan Normal University, Zhanjiang, China
[2]Faculty of Humanities and Social Sciences, City University of Macau, Macao SAR, China
403312677@qq.com

Abstract: *This study explores a big data-based precision teaching framework in college English, utilizing the U-Campus AI platform. A one-semester experiment with 66 freshmen incorporated real-time data collection, learning feedback, homework digitalization, error correction, and personalized learning. Results show the experimental class's CET-4 passing rate reached 70.96%, 14.73 % higher than that of the control group, with significant improvements in students' learning initiative and autonomy. Data from the web-based questionnaire reveal that up to 74.31% participants have a positive attitude toward this new teaching approach, recognizing its effectiveness in enhancing engagement and learning outcomes The findings of this study validate the benefits of the teaching framework which not only improves learning performance and student motivation, but also supports teachers' professional development and enables more personalized, data-driven teaching decisions. This offers valuable insights for foreign language teaching reform in higher education, as institutions increasingly utilize big data and AI technologies to deliver tailored, student-centered instruction that cultivates comprehensive growth and core competencies.*

Keywords: *Big data; Data-driven; Precision teaching; Personalized learning; Smart educational ecosystem; Human-AI enhancement*

1. Introduction

In 2022, the 20th National Congress of the Communist Party of China included "Promoting education digitalization" in its report for the first time, assigning education a new mission in the comprehensive construction of a modern socialist nation and outlining a strategic framework for the future development of education digitalization, which holds significant importance. Education digitalization serves as a critical foundation for building a strong education system. In the face of the digital era, education must adapt to societal changes and accelerate transformation to cultivate a new generation equipped for the future. With revolutionary breakthroughs in information technology and the exponential growth of internet data, the era of educational big data has arrived[1]. Technologies such as AI, big data, and blockchain have increasingly fostered interdisciplinary integration, opening up new avenues for innovation[2]. In 2015, the State Council issued the *Initiatives for Promoting Big Data Development*, emphasizing the need to explore the role of big data in transforming educational methods, promoting educational equity, and improving education quality. In 2022, the Department of Higher Education of the Ministry of Education in China identified the comprehensive advancement of higher education digitalization as a key priority, urging universities to adapt to the demands of higher education universalization, lifelong learning, personalized development, and modernized governance[3]. Institutions were called to accelerate the construction of a new form of higher education characterized by digitalization.

Data-driven approaches are a hallmark of smart education, emphasizing the use of vast amounts of data to transform and upgrade traditional educational models. The smart education ecosystem leverages cloud-edge-terminal integration and employs algorithms and reasoning to achieve data sharing, knowledge interconnection, and collective intelligence integration. The deep integration of big data and education has made data-driven precision teaching a focal point in educational informatization reforms. Against this backdrop, exploring how to integrate big data with college English teaching, fully utilize data mining technologies, and achieve precision teaching has become an urgent topic of inquiry.

ISSN 2616-5783 Vol.8, Issue 2: 7-14, DOI: 10.25236/AJHSS.2025.080202

Currently, the large-scale teaching data accumulated in blended college English teaching (combining online and offline methods) has not been fully mined or utilized. Most foreign language teachers in higher education still rely on subjective experience for teaching decisions. Therefore, it is essential to construct a big data-driven precision teaching system for foreign language education in the context of education digitalization. Foreign language teaching in the digital age must move toward a hybrid of virtual and physical environments, enhanced by human-machine collaboration, entering a new realm of big data-driven teaching. This study innovatively applies precision teaching theory to empirical research in college English teaching, utilizing the U-Campus AI platform to achieve full-process data collection and analysis. It aims to provide a replicable and scalable precision teaching practice model, offering theoretical and practical support for foreign language teaching reform in higher education.

The theoretical significance of this research lies in enriching the application of precision teaching theory in higher education, exploring data-driven foreign language teaching models, and providing new perspectives for localizing precision teaching theories. The practical significance lies in offering actionable implementation pathways for foreign language teaching reform in higher education, improving teaching efficiency, reducing students' academic burden, promoting educational equity, and facilitating the shift from experience-based to data-driven teaching models, thereby enhancing the scientific basis of teachers' instructional decisions.

The goal of this study is to construct a big data-driven precision teaching framework for college English and validate the effectiveness of this model in college English teaching. To achieve this goal, the study will address the following research questions:

(1) What are the strategies and pathways of a data-driven precision teaching framework?

(2) Can data-driven teaching interventions significantly improve students' learning outcomes?

2. Literature Review

2.1 Definition of Precision Teaching (PT)

Precision Teaching (PT), originating from behaviorist theory, was initially applied in the field of special education and later introduced into general education. It emphasizes the use of measurement and data analysis to design and adjust teaching strategies to better meet students' learning needs . PT was first proposed in the 1960s by American scholar Ogden Lindsley, based on behaviorist theory. Initially, it was used in special education to optimize teaching strategies through measurement and data analysis, aiming to maximize students' learning outcomes. Precision Teaching refers to a teaching approach supported by information technology, which tracks, records, and analyzes data on students' learning processes and their underlying causes[4]. This data provides a scientific basis for instructional design, teaching decisions, guidance, personalized interventions, and remedial strategies for students. The core concept of Precision Teaching is "assessment to support learning." Some scholars also argue that PT assists teachers in conducting targeted, differentiated, and individualized instruction. In recent years, PT has gradually expanded to areas such as mathematics and reading in primary education.

2.2 Current Research Status

Maloney (1998) described Precision Teaching as a measurement and decision-making technique based on behavior frequency and rate of change. Initially, it was used to track the learning performance of elementary school students and support data-driven decision-making. Over time, it evolved into a framework for evaluating the effectiveness of any given teaching method across various disciplines and educational stages. International research on PT has primarily focused on children (Figure 1 Network Visualization of Themes in Precision Teaching Research). Downer (2007) conducted four-minute daily PT interventions with children who had reading difficulties, showing significant weekly improvements in reading efficiency. Griffin & Murtagh (2015) demonstrated that PT enhances students' reading accuracy, fluency, and overall language skills. Gallagher (2006) organized interventions for "struggling learners" to master multiplication tables, with experimental results showing an increase in students' average scores from 16.38 to 22.75. Lambe & Murphy (2015) studied the impact of PT interventions on the reading fluency of special needs children aged 7–8, with positive results.

ISSN 2616-5783 Vol.8, Issue 2: 7-14, DOI: 10.25236/AJHSS.2025.080202

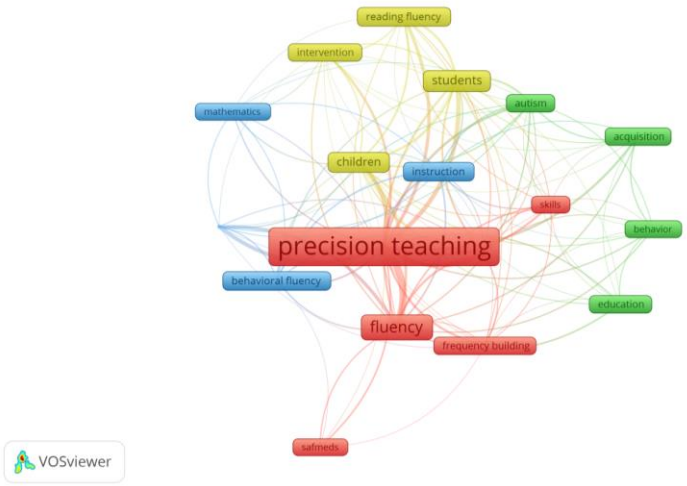

Figure 1: Network Visualization of Thematic Trends in International Precision Teaching Research

With rapid advancements in big data, cloud computing, and data mining technologies, Precision Teaching has gained increasing attention from domestic scholars. Figure 2 demonstrate the thematic trends in PT research in China. Zhu was the first one to introduce information technology into Precision Teaching, exploring how to construct PT models supported by technology[5]. Wan et al. proposed an operational framework and implementation pathway for big data-driven PT[6]. Lei et al suggested to make precision teaching decisions based on pre-learning data analysis[7]. Yang et al pointed out a new direction for data-driven teaching paradigms in the era of big data[8]. Liu et al claimed to empower the personalized learning with artificial intelligence[9].

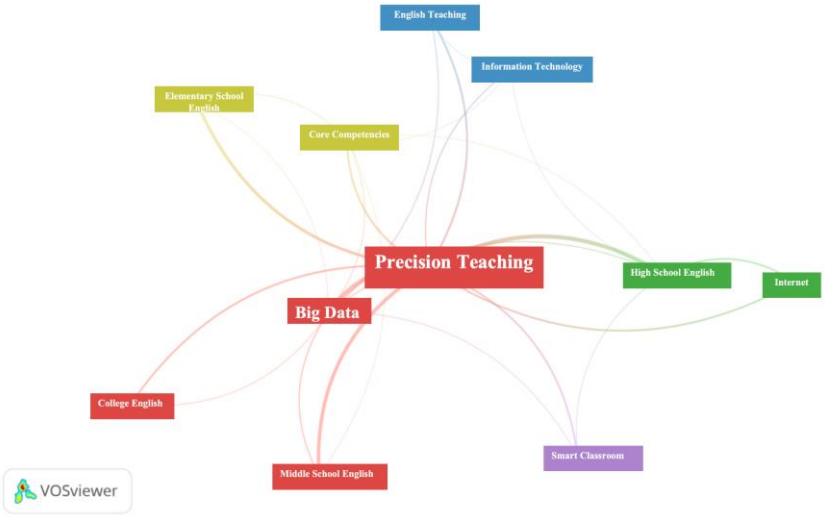

Figure 2: Network Visualization of Thematic Trends in Precision Teaching Research within China

Review of the above literature reveals certain limitations in existing research on Precision Teaching. Firstly, international studies largely focus on mathematics and reading in primary education. Secondly, domestic studies primarily concentrate on the integration of Precision Teaching with information technology, with limited application to specific disciplines. Thirdly, there is currently no empirical research combining Precision Teaching with college English instruction. To address these gaps, this study explores a big data-driven Precision Teaching system for college English. It aims to enrich research in this field, validate the effectiveness of data-driven Precision Teaching in foreign language instruction, and achieve differentiated teaching and personalized learning. The ultimate goal is to guide students toward deep learning and holistic development while providing new practical pathways for foreign language teaching reform in higher education.

By utilizing artificial intelligence technology to integrate big data and teaching resources in college English education, an innovative teaching model is created with a focus on "big data analysis—development of learner profiles—precise delivery—personalized tutoring." This model aims

ISSN 2616-5783 Vol.8, Issue 2: 7-14, DOI: 10.25236/AJHSS.2025.080202

to meet the personalized learning needs of students and enable differentiated teaching. Big data empowers foreign language education, with precision teaching emerging as a new instructional paradigm in the context of educational digital transformation. Contemporary foreign language teachers are expected to understand the essential characteristics of precision teaching, relying on big data and utilizing artificial intelligence to construct learner profiles, select appropriate teaching content, create tailored teaching plans, conduct precise teaching evaluations, and implement data-driven foreign language classroom practices. This approach fosters an integrated "teaching-learning-evaluation" closed-loop system.

3. Strategies and Pathways

3.1 Strategies for Precision Teaching in College English

With the support of the U-Campus AI Smart Teaching Cloud Platform, college English teaching can comprehensively record and dynamically analyze the entire learning process of students, providing robust data support for precision teaching. By deeply mining students' learning behaviors and mastery of knowledge points, teachers can clearly identify students' problems and adjust their teaching strategies accordingly. The platform collects and monitors data on students, teachers, and teaching activities throughout the process, analyzing critical teaching data to enhance the depth and accuracy of data application. This provides timely, comprehensive, and precise support for teaching decisions. Such a data-driven precision teaching system not only promotes the informatization of the teaching process but also lays the foundation for the digital transformation of teaching models.

The data platform also provides teachers with students' "learning history," helping them accurately assess learning conditions and plan subsequent instruction. For example, the system can automatically record and summarize a student's learning challenges and weak knowledge areas over a semester, allowing teachers to review them at any time. By analyzing this data, teachers can identify the difficulties students face and their root causes, enabling them to provide more targeted guidance. The U-Campus AI platform presents information and data in visualized and charted formats, generating diagnostic reports based on statistical models to assist teachers in decision-making. Teachers can use these reports to assess the overall learning conditions of the class, adjust teaching activities, and address specific learning difficulties or errors by pushing targeted resources and exercises to students. This data-driven approach not only improves teaching efficiency but also significantly reduces teachers' workloads.

3.2 Implementation Pathways

The core of precision teaching lies in achieving personalized instruction through big data and intelligent technologies. Its implementation requires a well-established information-based teaching environment, including a combination of "platform + terminal + content." A big data precision teaching platform should be user-friendly and feature-rich, terminal devices such as mobile phones or tablets should facilitate rapid data collection, and teaching content must be progressively digitized. This content can be developed by teachers or sourced from high-quality educational materials. The specific steps for implementing precision teaching are: data preparation→data collection→data analysis→data utilization as shown in the flowchart of Figure 3.

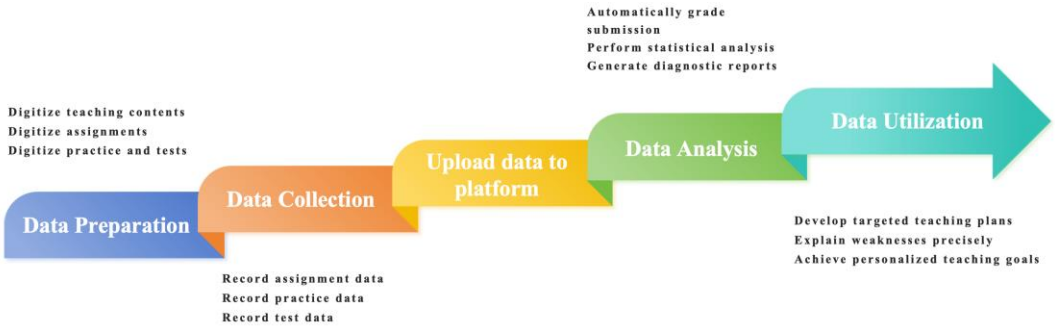

Figure 3: The Implementation of Precision Teaching

ISSN 2616-5783 Vol.8, Issue 2: 7-14, DOI: 10.25236/AJHSS.2025.080202

3.3 Classroom Teaching and Data Feedback

Classroom teaching is the core setting for precision teaching. One major reason for students' heavy academic burdens is teachers' inability to accurately assess learning conditions. The greatest value of big data precision teaching lies in its precision. By collecting data on students' classroom exercises and tests, teachers can quickly understand their knowledge mastery. During classroom exercises, the system provides real-time statistics on the accuracy rate and scoring rate of each question, enabling teachers to quickly identify high-error knowledge points for focused explanation. For individual student issues, teachers can provide one-on-one guidance, with the system automatically recording students' responses to support follow-up interventions. This data-driven approach significantly improves classroom efficiency and ensures the precision and relevance of teaching content.

Digitalizing assignments is another important component of precision teaching. Assignments are distributed through the platform, with objective questions automatically graded by the system and subjective questions graded by teachers, after which the system automatically aggregates the results into charts and data reports. Once students submit their assignments, the platform immediately provides answers and feedback, helping students quickly identify their mistakes. This efficient grading and feedback process not only speeds up response times but also reduces teachers' workloads.

3.4 Data-Driven Personalized Learning

The big data platform supports personalized learning for students, with the "error notebook" feature being a key tool. Traditional methods of organizing errors are time-consuming and labor-intensive, but the big data platform can automatically collect students' errors, generate error sets and knowledge maps, and provide relevant resources and practice questions to help students efficiently address weak points. Students can view their error records at any time on the platform and engage in targeted learning, avoiding repetitive tasks and wasted time. Meanwhile, teachers can monitor students' error correction completion rates and scores through the platform, ensuring students complete error-based practice and adjusting teaching content and progress based on error data.

3.5 Precision Evaluation and Talent Development

The ultimate goal of precision teaching is to achieve comprehensive development and personalized cultivation of students. By thoroughly collecting data such as classroom interactions, assignment completion, and exam results, the platform creates a comprehensive digital profile for each student. These profiles allow teachers to conduct precise analyses of individual students, specific knowledge points, and specific questions, enabling differentiated teaching and evaluation. For example, teachers can use data to identify students' weak subjects and knowledge areas, developing targeted intervention plans. For high-proficient students, teachers can provide more challenging resources and tasks to further stimulate their potential. This data-driven talent development model not only enhances students' learning outcomes but also ensures overall improvements in teaching quality.

4. Research Methodology

This study adopts a quasi-experimental research method, selecting both an experimental group (N=66) and a control group (N=69) from the 2024 cohort. The experimental group implements a data-driven precision teaching model, while the control group follows a traditional teaching approach. In the experimental group, student learning data is collected through the U-Campus AI intelligent teaching cloud platform, and personalized teaching interventions are applied, including the intelligent delivery of learning resources, error correction practice, and knowledge point reinforcement. In contrast, the control group relies on traditional teaching methods, where teachers plan lessons based on their experience.

Data collection focuses on both teaching data and student feedback. Teaching data includes classroom interactions, assignment completion rates, and test scores, while student feedback is gathered through questionnaires to assess their satisfaction with the teaching model and their learning experience. Quantitative data analysis uses SPSS 29.0 to statistically analyze the test scores of the experimental and control groups, validating the effectiveness of the teaching intervention. The experiment spanned one semester, with controlled variables including teachers' teaching experience, students' English proficiency, and teaching content, ensuring comparability between the two groups. The experimental

ISSN 2616-5783 Vol.8, Issue 2: 7-14, DOI: 10.25236/AJHSS.2025.080202

group utilized the platform to intelligently deliver personalized learning resources and provide targeted reinforcement training on weak knowledge points, ensuring the precision and relevance of teaching interventions.

5. Implementation Outcomes

This study, through scientific data analysis and precise teaching interventions, significantly improved the quality and effectiveness of college English teaching in experimental classes (N=66) of 2024 cohort, fostering the comprehensive development of students' English proficiency. The research achieved notable results in areas such as data mining, teaching strategy optimization, and outcome evaluation, providing robust support for the transition of foreign language education toward intelligent and personalized models.

The researcher designed and implemented a series of teaching interventions that effectively enhanced students' English learning outcomes in the experimental group. Notably, the pass rate for the College English Test Band 4 (CET-4) in the experimental group (EG) reached 70.96%, 14.73 percentage points higher than the average pass rate (56.23%) of those in control group (CG). This result demonstrates the significant impact of the precision teaching model on improving students' English learning outcomes.

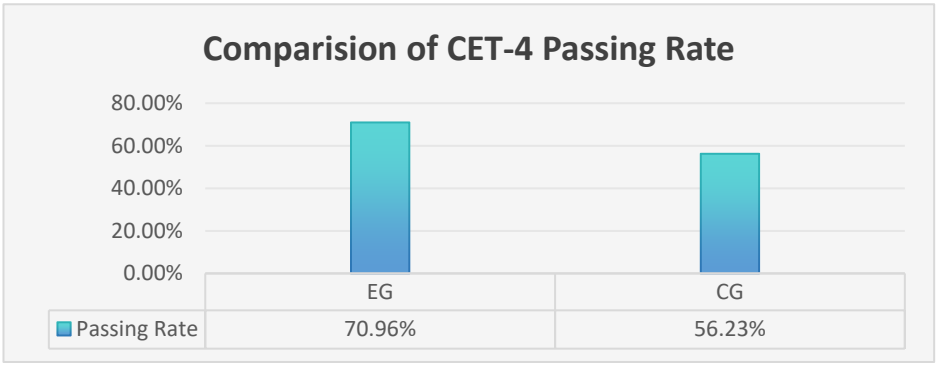

Figure 4: Comparison of CET-4 Passing Rate between EG and CG

After a semester of experimental reform in precise college English teaching, when conducting an attitude survey with a questionnaire distributed to the participants, the vast majority of students expressed approval for this new teaching method with up to 74.31% positive attitude (see the Figure 5) . They believed it helped identify their weaknesses in English learning, allowing teachers to accurately pinpoint common issues among the students in the class. During focused lectures, teachers provided clear explanations to address learning difficulties, thereby improving teaching efficiency. Additionally, the precise AI diagnostic system can analyze each student's weak areas of knowledge and automatically recommend corresponding exercises for reinforcement. This facilitates personalized learning and targeted training.

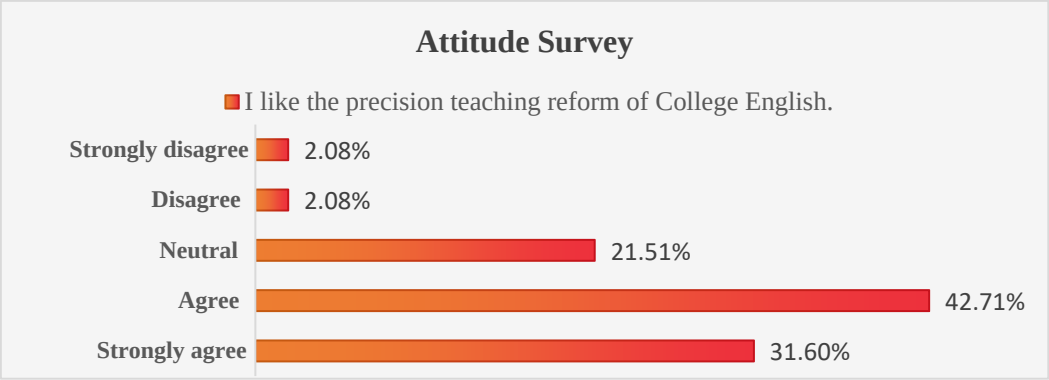

Figure 5: Participants' Attitude toward College English Precision Teaching

This study developed a precision teaching framework for college English based on evidence-based teaching decisions. The framework not only improved the teaching quality of the experimental group but also has strong scalability, making it applicable to a broader range of students and benefiting more

ISSN 2616-5783 Vol.8, Issue 2: 7-14, DOI: 10.25236/AJHSS.2025.080202

teachers and learners. Students' daily performance and classroom behaviors were recorded, leveraging this extensive data to analyze common challenges and individual needs in English learning as shown in the Figure 6 below. During in-person classes, the teacher focused on explanations and answering questions, addressing students' specific learning difficulties. This data-driven precision decision-making significantly improved teaching outcomes and efficiency.

Figure 6: Screenshot of the Teacher's Dashboard

6. Pedagogical Implications

6.1. Transforming Teaching Concepts and Methods

Big data has revolutionized college English teaching by enabling data-informed adjustments to content and methods, replacing inefficient "one-size-fits-all" approaches with student-centered instruction. Students benefit from personalized self-directed learning supported by pre-class diagnostics, in-class practice, and post-class review, forming a complete learning loop. This dynamic integration of technology not only tailors teaching to individual but also fosters active engagement and ensures continuous improvement in language proficiency.

6.2. Empowering Personalized Teaching and Improving Classroom Quality

Precision teaching integrates information technology with classroom instruction, enabling real-time feedback on students' performance. Teachers can adjust content to address common issues and focus on key areas, maximizing classroom efficiency. Tools like virtual classes and knowledge maps support differentiated assignments and personalized learning, creating a closed-loop system that enhances teaching quality and student outcomes.

6.3. Fostering Holistic Development

The ultimate goal of precision teaching is to support students' comprehensive growth and core competency development. By providing data-driven insights, it helps teachers guide students more effectively, enhances self-directed learning, and fosters critical thinking and problem-solving skills, promoting well-rounded development. Moreover, this approach equips students with the adaptability and lifelong learning capabilities necessary to thrive in an increasingly dynamic and digitized world.

6.4. Optimizing Guidance and Enriching Resources

Big data analysis informs educational decisions, refining teaching methods and optimizing resource allocation. Schools can provide tailored, high-quality learning materials based on student needs, enriching learning experiences and improving outcomes. Additionally, this data-driven approach enables educators to identify trends and patterns in student performance, offering actionable insights from curriculum improvement and more targeted support for diverse learners.

6.5. Enhancing Efficiency and Development

Precision teaching leverages big data to shift research activities from experience-based exploration to data-driven analysis. By focusing on students' learning data, research can target their "zone of proximal development," enabling precise planning of teaching goals and strategies. This data-centered

ISSN 2616-5783 Vol.8, Issue 2: 7-14, DOI: 10.25236/AJHSS.2025.080202

approach improves the quality and efficiency of research, driving classroom reform and the implementation of innovative teaching methods. Furthermore, it fosters a deeper understanding of individual and collective learning atmosphere, paving the way for more effective, evidence-based educational practicum that meet the evolving demands of modern education.

7. Conclusion

With the continuous advancement of educational informatization, this research constructs a data-driven smart teaching framework and explores the application of big data and AI in college English teaching, laying a solid theoretical and practical foundation for the development of smart education. Precision teaching, driven by data, helps teachers significantly improve efficiency, reduce workload, and gain real-time insights into each student's learning progress, enabling more targeted guidance[10]. It effectively enhances students' overall competencies. By providing detailed learning data, PT helps students diagnose and improve their learning habits, strengthen self-directed learning abilities, and engage in personalized learning based on their needs, schedules, and progress. It also stimulates students' interest in subjects, deepens their understanding of disciplinary knowledge, and guides them to explore and solve problems from broader perspectives and systematic frameworks, thereby achieving the goal of cultivating core competencies.

In conclusion, this study deeply integrates modern information technologies into college English teaching, focusing on the personalized learning and precision of teaching content, methods, and evaluation. Through this empirical study, the research not only improves teaching efficiency and quality but also provides practical pathways for promoting educational equity and driving teaching innovation. It also provides practical guidance and theoretical foundations for optimizing resource allocation and advancing teaching reform in higher education. The findings provide valuable insights for frontline teachers in implementing precision teaching, differentiated instruction, and enhancing teaching efficiency and quality in the field of English language learning. They also hold significant practical value for optimizing foreign language teaching effectiveness and advancing the development of smart foreign language education in the long run.

Acknowledgment

This study was funded by the Foreign Languages Informatization Development Program Project of the School of Foreign Studies at Lingnan Normal University, titled "*Research on Data-driven Precision Teaching Reform for College English in the Context of Educational Digital Transformation*".

References

[1] Chen Jianlin, Jia Zhenxia. Exploration and Research on Informatized Foreign Language Learning Methods in the Era of Big Data [J]. Foreign Language Education in Electrification, 2017(8):3-8.
[2] Gong Wen. Reshaping the EFL Formative Assessment Pedagogy with Blockchain Technology [J]. International Journal of English Linguistics, vol 13, No.1, 2023.
[3] Ministry of Education. Accelerate the Advancement of Educational Digitalization, Build a Strong Educational Nation [N]. Ministry of Education of the People's Republic of China, 2022. http://www.moe.gov.cn/jyb_xwfb/s5148/202212/t20221209_1028299.html
[4] Lindsley, O.R. Precision Teaching [J] Journal of Applied Behavior Analysis, 1992(1):51-57.
[5] Zhu Zhiting, Peng Hongchao. Knowledge Teaching Supported by Information Technology: Energizing Precision Teaching [J]. China Educational Technology, 2016(1):18-25.
[6] Wan Liyong, Huang Zhifang, Huang Huan. Precision Teaching Driven by Big Data: Operational Framework and Implementation Path [J]. Modern Educational Technology, 2019(1):31-36.
[7] Lei Yunhe, Zhu Zhiting. Precision Teaching Decisions Based on Pre-Learning Data Analysis [J]. China Educational Technology, 2016(6):27-35.
[8] Yang Xianmin, Luo Jiaojiao, Liu Yaxin. Data-Driven Teaching: A New Direction for Teaching Paradigms in the Era of Big Data [J]. Research on Educational Electrification, 2017(12):13-20.
[9] Liu Bangqi, Zhang Jinxia, Xu Jiahui. Empowering Personalized Learning with Artificial Intelligence: Technology Framework, Industry Features, and Trends—Analysis Based on Empirical Data in the Intelligent Education Industry [J]. Research on Educational Electrification, 2021(2):70-77.
[10] Johnson, K., Street, E.M. Response to Intervention and Precision Teaching: Creating Synergy in the Classroom [M]. New York: Guilford Press, 2012.